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WIPING CLOTH, WIPE FOR PRECISION MACHINES, WIPE FOR CLEAN ROOMS, AND METHOD OF MANUFACTURING WIPING CLOTH

Inventors:

000003159
Yoshinori Hosoda
Shiga Works, Toray Industries, Inc.
1-1-1 Sonoyama, Otsu-shi,
Shiga-ken

Shigeru Ota
Shiga Works, Toray Industries, Inc.
1-1-1 Sonoyama, Otsu-shi,
Shiga-ken

Applicant:

Toray Industries, Inc.
2-2-1 Muro-machi, Nihonbashi,
Chuo-ku, Tokyo

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Abstract

Purpose

The purpose of this invention is to provide a type of wiping cloth, a type of wipe for precision machines, and a type of wipe for clean rooms, which generate little dust, are free of dielectric breakdown and have a high wiping property, as well as a method for manufacturing them.

Constitution

The wiping cloth of this invention is characterized by the fact that it is made of a knit or woven fabric composed of ultrafine fiber filaments with a filament size of 0.1 denier or smaller, and said knit or woven fabric contains virtually no hydrophilic substance or electroconductive substance. The wipe for precision machines of this invention is characterized by the fact that the wiping portion is made of said wiping cloth. The wipe for clean rooms of this invention is characterized by the fact that the wiping portion is made of said wiping cloth. The method for manufacturing the wiping cloth of this invention is characterized by the fact that a knit or woven fabric made of ultrafine fiber filaments with a filament size of 0.1 denier or smaller is manufactured by performing all steps from fiber manufacturing to finishing processing for yarns virtually free of hydrophilic substances and electroconductive substances.

Claims

1. A type of wiping cloth characterized by the fact that it is made of a knit or woven fabric composed of ultrafine fiber filaments with a filament size of 0.1 denier or smaller, and said knit or woven fabric contains virtually no hydrophilic substance or electroconductive substance.

2. The wiping cloth described in Claim 1 characterized by the fact that said knit or woven fabric is made of said ultrafine fibers and filament yarns with a shrinkage rate higher than that of said ultrafine fibers.

3. A type of wiping cloth [sic, The wiping cloth described in Claim 1] characterized by the fact that the content of said hydrophilic substance or electroconductive substance is 0.5 wt% or less.

4. A type of wiping cloth [sic, The wiping cloth described in Claim 1] characterized by the fact that the content of said hydrophilic substance or electroconductive substance is 0.1 wt% or less.

5. The wiping cloth described in Claim 1 characterized by the fact that it contains 30 wt% or more ultrafine fibers with a filament size of 0.1 denier or smaller.

6. The wiping cloth described in Claim 1 characterized by the fact that the filament yarns having a shrinkage rate higher than that of said ultrafine fibers have a filament size larger than that of said ultrafine fibers.

7. The wiping cloth described in Claim 1 characterized by the fact that said ultrafine fibers are formed selectively on the surface of the knit or woven fabric.

8. The wiping cloth described in Claim 1 characterized by the fact that the ultrafine fibers are polyester filaments.

9. The wiping cloth described in Claim 1 characterized by the fact that the dust generating rate of particles with a size of 5 μm or larger measured according to JIS B-9923 (shaking method) of said knit or woven fabric is 10 particles/ft^3•100 cm^2 or less.

10. The wiping cloth described in Claim 1 characterized by the fact that the water absorption speed of said knit or woven fabric measured according to JIS L-1096 is 1 sec or lower.

11. The wiping cloth described in Claim 1 characterized by the fact that the water absorptivity of the knit or woven fabric measured according to JIS L-1096 is 200 wt% or higher.

12. A type of wipe for precision machines characterized by the fact that the wiping portion is made of said wiping cloth described in Claims 1-11.

13. The wipe for precision machines described in Claim 12 characterized by the fact that said precision machines refer to machines used in the process of manufacturing liquid crystal materials and semiconductor devices as well as their products.

14. A type of wipe for clean rooms characterized by the fact that the wiping portion is made of said wiping cloth described in Claims 1-11.

15. The wipe for clean rooms described in Claim 14 characterized by the fact that said clean rooms refer to the rooms for manufacturing liquid crystal materials and semiconductor devices.

16. The wipe for clean rooms described in Claim 14 characterized by the fact that the wipe for clean rooms is packaged in a clean room with a number of dispersed particles with a particle size of 0.5 μm or larger of 100 particles/ft^3 or less.

17. A method for manufacturing wiping cloths characterized by the fact that a knit or woven fabric made of ultrafine fiber filaments with a filament size of 0.1 denier or smaller is manufactured by performing all steps from fiber manufacturing to finishing processing for yarns virtually free of hydrophilic substances and electroconductive substances.

18. The method for manufacturing wiping cloths described in Claim 17 characterized by the fact that after a knit or woven fabric made of ultrafine fibers with a filament size of 0.1 denier or smaller and filament yarns with a shrinkage rate higher than that of said ultrafine fibers is

subjected to a heat treatment, the surface of the knit or woven fabric is subjected to water-jet punch processing.

19. The method for manufacturing wiping cloths described in Claim 17 characterized by the fact that said water-jet punch processing is performed using filtered water under a pressure in the range of 30-120 kgf/cm^2.

20. The method for manufacturing wiping cloths described in Claim 17 characterized by the fact that said heat treatment includes scouring and dyeing processing.

Detailed explanation of the invention

[0001]

Technical field of the invention

This invention pertains to a type of wiping cloth which generates little dust, that is, a wipe for precision machines or clean rooms, as well as its manufacturing method.

[0002]

Prior art

With the rapid advance into the age of electronic information, not only eyeglasses and lenses of the prior art, but also screens of liquid crystal units and other electronic equipment have to be highly clean with removal of pollutants. In addition, no dust should be produced from a wiping cloth, especially dust containing hydrophilic substances or electroconductive substances, as they may cause dielectric breakdown. In particular, the dust generation rate must be low for wiping [cloths] used in wiping products and manufacturing equipment in processes of manufacturing liquid crystal materials and semiconductor devices in clean rooms. In fields where fluff and dust generation are undesired, conventional cotton and paper cannot be used as the wiping cloth. In recent years, it has been proposed that a knit or woven fabric prepared using ultrafine fibers be used as a wiping cloth. For example, Japanese Kokai Patent Application No. Sho 61[1986]-103428 proposed a type of wiping cloth made of cloth prepared from ultrafine fibers with a size of 0.9 denier or smaller and having a high bulk density. Also, Japanese Kokai Patent Application No. Sho 63[1988]-211364 proposed a method for manufacturing a type of interwoven knit or woven fabric made of ultrafine fibers with a size of 0.2 denier or smaller and fibers with a size of 0.5-10 denier. However, the fabrics proposed in these patent applications have a hard feel, and they are either too smooth for materials made of glass as a substrate or too rough to perform the wiping operation well. This is undesired. Also, for knit fabric, as it characteristically has a good stretching property, there is a significant deformation after drawing. Also, it is too smooth or its net is too rough to display a good wiping property. In addition, it is difficult to realize a low dust generating rate for the wiping cloth.

[0003]

Problems to be solved by the invention

The purpose of this invention is to solve the aforementioned problems of the prior art by providing a type of wiping cloth, a type of wipe for precision machines, and a type of wipe for clean rooms with little dust generation and a high wiping property free of dielectric breakdown as required by use in industry with a high demand on cleanness, as well as their manufacturing method.

[0004]

Means to solve the problem

In order to solve the aforementioned problems, this invention has the following constitution. The wiping cloth of this invention is characterized by the fact that it is made of a knit or woven fabric composed of ultrafine fiber filaments with a filament size of 0.1 denier or smaller, and said knit or woven fabric contains virtually no hydrophilic substance or electroconductive substance. The wipe for precision machines of this invention is characterized by the fact that the wiping portion is made of said wiping cloth. The wipe for clean rooms of this invention is characterized by the fact that the wiping portion is made of said wiping cloth. The method for manufacturing the wiping cloth of this invention is characterized by the fact that a knit or woven fabric made of ultrafine fiber filaments with a filament size of 0.1 denier or smaller is manufactured by performing all steps from fiber manufacturing to finishing processing for yarns virtually free of hydrophilic substances and electroconductive substances.

[0005]

Embodiment of the invention

The present inventors performed extensive studies on the development of a type of material appropriate for a wiping cloth and a wipe for use in cleaning precision machines and products in processes of manufacturing liquid crystal materials and semiconductor devices and free of dust generation and dielectric breakdown. It was found that by using a cloth made of ultrafine fiber filaments and thoroughly free of hydrophilic substances and electroconductive substances, it is possible to provide a type of wiping cloth with a very high reliability.

[0006]

Feed materials for forming the wiping cloth of this invention include ultrafine filaments of polyester, polyamide and other synthetic fibers. When the proportion of said ultrafine fiber filaments in the fibers that form the wiping cloth is at least 30 wt%, the wiping property is

ultrafine fibers

excellent. Here, the term ultrafine fibers refers to fibers with a filament size of 0.1 denier or smaller, or preferably in the range of 0.08-0.01 denier, or more preferably in the range of 0.06-0.05 denier. When other fibers are used together with the ultrafine fibers, it is preferred that high-shrinkage filament yarns of 1 denier or larger be used. Although there is no special limitation on the fibers other than being ultrafine, in order to realize a high bulk density of the cloth, high-shrinkage yarns are preferred. Especially, those with a fiber size of 1 denier or larger, preferably in the range of 2-6 denier, are preferred. As far as the proportions of ultrafine fibers and high-shrinkage yarns are concerned, the proportion of ultrafine fibers with respect to the weight of the cloth should be 30% or more, or preferably in the range of 50-80 wt%, or more preferably in the range of 60-70 wt% in consideration of the bulk density, feel, and wiping property. Essentially, the remaining portion is made of high-shrinkage yarns of 1 denier or larger. There is no special limitation on the shrinkage rate of the high-shrinkage yarns of 1 denier or larger, as long as they have a high shrinkage property. It is important to ensure that they have higher shrinkage under heat than the ultrafine fibers. If the boiling water shrinkage rate of the ultrafine fibers is in the range of 4-8%, the shrinkage rate of the high-shrinkage yarns should be in the range of 10-25%. In particular, it is preferred that the boiling water shrinkage rate of the high-shrinkage yarns be 4-8% higher than that of the ultrafine fibers. That is, in heat treatment, the high-shrinkage yarns display a greater shrinkage than the ultrafine fibers inside fiber bundles of the knit fabric. On the other hand, the ultrafine fibers disturb the configuration of the single filaments so as to increase the bulk density of the surface of the cloth.

high-shrinkage filament

relative heat shrinkage

[0007]

The cloth may be either woven fabric or knit fabric. Woven fabric is preferred as it has less dust generation for the wiping cloth. In addition, woven fabric is better than knit fabric with respect to bulk density and wiping ability. These are advantages of woven fabric.

[0008]

particle release

For the wiping cloth for wiping precision machines and for use in clean rooms as the purpose of this invention, particles with a particle size of 5 μm or larger should be entirely absent or less than 10 particles/ft • 100 cm^2. In addition, in the semiconductor manufacturing process that requires a high cleanness, generation of foreign objects with a particle size of 1 μm or larger should be avoided with the greatest of effort. Especially, if a hydrophilic substance or electroconductive substance is present in the dust generated, the blooming phenomenon or dielectric breakdown takes place, which are critical disadvantages. According to this invention, said hydrophilic and electroconductive substances are excluded as much as possible, so as to improve the reliability in cleaning of precision machines and clean rooms.

[0009]

That is, when the wiping cloth of this invention is manufactured, great effort is made to exclude the following types of substances that are used in dyeing processing, softening processing, etc. and can cause blooming and dielectric breakdown from all of the processes involved in manufacturing of fibers as well as various processing steps of the knit or woven fabric: polyalkylene glycol-based compounds, water-soluble polyester and other hydrophilic processing agents, polyacrylic ester and other soiling inhibitors, cation-based polymer surfactants and other static inhibitors, higher alcohol sulfuric esters, betaine type amphoteric surfactants, and other dispersants, electroconductive metals and electroconductive metal compounds, carbon powder, static inhibiting fibers, carbon fibers, and other electroconductive fibers, static inhibiting resins, etc. That is, the wiping cloth of this invention is characterized by the fact that the content of hydrophilic substance or electroconductive substance should be 0.5 wt% or less, or preferably 0.1 wt% or less, or more preferably zero.

[0010]

product specif.

For the wiping cloth for use in clean rooms with a dispersed particle number measured using JIS B-9923 "light-scattering type particle counting method" of 100 particles/ft^3 or less, in addition to a good wiping property and little dust generation, it should also have high rate of water absorption and a high water absorptivity for absorbing dirt. In particular, it should have instant water absorptivity, or more specifically a water absorptivity of 200% or higher, or preferably 300% or higher. Also, components that can be extracted with water and oils should be absent or in a small amount. Such a function can be realized by means of an appropriate filling density of the structural fibers. For this purpose, the surface of the cloth is subjected to water-jet punch processing. By means of said water-jet punch processing, the dust contained in the wiping cloth and the dust generated in the wiping operation can be minimized. At the same time, the form of the cloth is made stable, the effect of fibers interweaving with each other is well realized, so that little dust is generated in wiping operation. In addition, there is an effect of removing foreign objects attached on the cloth by means of water flow.

[0011]

In the following, a typical method of manufacturing the wiping cloth of this invention will be explained. Caution should be taken in manufacturing the wiping cloth of this invention to ensure that yarns virtually free of hydrophilic substances and electroconductive substances are used in all processes from manufacturing of fibers to finishing processing.

[0012]

First of all, polyester filament yarns made of island type composite fibers with a resin composition free of hydrophilic substances and electroconductive substances and high-shrinkage yarns are set aligned, and the sea component is removed to obtain composite fibers composed of ultrafine fibers with a size of 0.1 denier or smaller and high-shrinkage yarns. An effective way for removing the sea component is a treatment performed in the presence of an alkali. Conventionally, sodium hydroxide is used for this purpose. Also, one may make use of separation type divided fibers. Also, false twist processing or the like may be adopted in manufacturing composite fibers.

[0013]

Any method may be adopted in manufacturing the knit or woven fabric. For knit fabric, tubular knitting with the interlock system is effective in improving productivity and preventing stray fibers in cutting. After the obtained cloth, that is, knit fabric, is treated to remove the sea component to form ultrafine fibers, treatment is performed in hot water at 100°C or higher. Then, the knit fabric is dyed and finish set as for the conventional type of knit fabric. In this case, too, it is important to ensure that processing is carried out using yarns free of hydrophilic substances or electroconductive substances.

[0014]

When the wiping cloth of this invention is manufactured, water-jet punch processing is carried out. In this processing, filtered and cleaned water is injected from fine holes onto the surface of the cloth under a certain pressure. The hydraulic pressure should be in the range of 30-120 kgf/cm^2, or preferably in the range of 50-80 kgf/cm^2. If the pressure is lower than 30 kgf/cm^2, the effect of this processing can hardly be displayed, the form stability is insufficient, and the effect of fibers interweaving with each other is insufficient. On the other hand, when the pressure is higher than 120 kgf/cm^2, filaments of ultrafine fibers may be cut under the hydraulic pressure, leading to fluffing. This is undesired.

[0015]

After water-jet punch processing, the cloth is finish set, and, at the same time, it is dry heated and dried at a temperature of 100°C or higher to dissipate the moisture and hydrophilic components. In this case, too, it is essential to ensure that neither hydrophilic substance nor electroconductive substances remain in the cloth. Then, the cloth is cut to the product size. Finally, it is washed with pure water (distilled water, ion-exchanged water, etc.) and is dried, followed by clean packaging to form a finished product. In this case, clean packaging refers to

packing in a clean room in which the concentration of dispersed particles with a size of 0.5 μm or larger of 100 particles/ft^3 or lower as measured according to JIS B-9923.

[0016]

The wiping cloth of this invention has little dust generation, and its excellent effects and performance can be displayed for precision machines and in clean rooms. Consequently, said wiping cloth may be used as is, or used to form the wiping portion of a wipe for cleaning equipment and products in processes of manufacturing liquid crystal materials and semiconductor devices as well as electronic information materials, etc. free of dust generation, blooming and dielectric breakdown. In addition, it can be used in high-precision wiping of oil films, dirt, etc. from pearls, gems, furniture, automobile windows, etc.

[0017]

Application examples

In the following, this invention will be explained in more detail with reference to application examples. Evaluation of the dust generating property is performed according to JIS-B9923 (shaking method). The water absorptivity is evaluated according to JIS-1096. The amount of absorbed water is determined by submerging the sample in water for 2 min, then lifting up the sample, and measuring the increase in the weight after allowing to drip for 1 min.

[0018]

The wiping property is evaluated using the following method. By means of a syringe, about 5 mg of silicone oil SH200 (product of Toray Dow Corning Silicone Co., Ltd.) are allowed to fall on a glass panel. A sample (wiping cloth) with a thickness of about 1 mm and fixed on one end surface of a cylindrical load with a diameter of 45 mm and weight of 1 kgf is set on said glass panel and is pulled to move at a speed of 1 m/min to wipe off the silicone oil. Then, a toner (SF-76T, product of Sharp Corp.) for dry copiers is shaken onto the glass panel and then blown off with compressed air (1 kgf/cm^2). Cello tape (registered trademark of Sekisui Chemical Industry Co., Ltd.) is applied to take up the residual toner remaining on the glass panel. The degree of toner attached on the Cello tape is judged. Judgment is made by the naked eye with a 5-grade rating, with grade 5 referring to the case when no toner is attached at all (silicone oil is completely wiped off from the glass panel) and with grade 1 referring to the case when a large amount of toner is left.

[0019]

Application Example 1

The ultrafine fibers used in this application example are island type polyester fibers of 50 denier and 9 filaments (70 islands/filament, product of Toray Co., Ltd.). The island component is polyethylene terephthalate, and the sea component is an alkali hot water soluble polyester made of a copolymer of terephthalic acid and 5-sodium sulfoisophthalic acid as the acid component of the polyester (ratio of sea to island of 10/90). The boiling water shrinkage rate of the yarns is 5.8%.

[0020]

The high-shrinkage yarns used in this application example are polyester yarns of 30 denier and 12 filaments (product of Toray Co., Ltd.). The shrinkage rate of the yarns is 13.8%. On the other hand, the ultrafine fibers without removal of the sea component were set aligned to the high-shrinkage yarns to form a gray form for knitting using the interlocking system on a tubular knitting machine (32 G, 36 inch). The gray form was subjected to heat treatment at 130°C for 20 min, followed by a treatment using 1% aqueous solution of sodium hydroxide (using distilled water) at 80°C for 30 min so remove the sea component completely. Then, under a pressure of 80 kgf/cm^2, filtered water was used for water-jet punch processing. Then, heat setting was performed at 130°C. With a basis weight of 210 g/m^2, the gray form was shrunk to 68% its width and 72% its length.

266 °F

[0021]

The obtained cloth has a gentle chamois texture, excellent dimensional stability, and good operability as a wiping cloth. Also, the cloth was cut to 100-g samples, and ethanol was used to extract the hydrophilic substance using the Soxhlet method. It was found that the extracted amount was 0%.

[0022]

Application Example 2

Knit fabric was manufactured using the same composite yarns as those prepared in Application Example 1. Just as in Application Example 1, caution was taken to avoid mixing of hydrophilic substances or electroconductive substances into the cloth. After removal of the sea component, water-jet punch processing was carried out on the surface under a pressure of 80 kgf/cm^2. Also, water-jet punch processing was performed from the inner surface under a pressure of 100 kgf/cm^2. Then, heat setting was performed at 160°C. With a basis weight of

320 °F

218 g/m^2, the gray form was shrunk to 68% its width and 70% its length. The content of hydrophilic substance in the cloth was found to be 0%.

[0023]

The obtained cloth has a gentle chamois texture, excellent dimensional stability, and good operability as a wiping cloth.

[0024]

For the cloth samples obtained in Application Examples 1-2, properties required of a wiping cloth for use in clean rooms were evaluated, with the results listed in Table 1.

[0025]

Table 1

② ③	① 実施例1	① 実施例2
発塵性 [個／ft³・100 ml]		
④ 0.3 ミクロン以上	26	18
1.0	14	9
2.0	8	5
5.0	3	2
⑤ 吸水率 (%)	286	237
⑥ 拭取性 タテ方向 (級)	4	4
ヨコ方向 (級)	4～5	4
⑦ 拭取作業性	○	○
風合	○	○
使い	○	○

Key: 1 Application Example
2 Dust generation property
3 Particles
4 0.3 μm or larger
5 Water absorptivity
6 Wiping property Longitudinal direction (grade)
Lateral direction (grade)
7 Wiping ability
Feel
Permanent deformation

For the cloths prepared in Application Examples 1 and 2 of this invention, there is little dust generation, and no hydrophilic substances. Consequently, there is no dielectric breakdown.

As it has a high water absorption rate and a high water absorptivity, the cleaning performance is excellent.

[0026]

Comparative Example 1

After submerging the wiping cloth prepared in Application Example 1 in a water-soluble polyester-based hydrophilic treatment agent (SR-1000, product of Takamatsu Oils and Fat Co., Ltd.), it was dried and heat set. The amount of the hydrophilic treatment agent attached on the cloth was 1.6 wt%. The surface grade and feel of the obtained cloth are similar to those in Application Example 1, and there is improvement in the rate of water absorption. However, blooming took place on the glass surface, thus it can not be used in practical application.

[0027]

Comparative Example 2

1.2 wt% carbon powder-containing static inhibiting fibers were mixed with the yarn composition of Application Example 1, and the mixture was knitted. Then, in the same way as in Application Example 1, water-jet punch processing and heat setting were performed to form a wiping cloth. Said carbon powder-containing static inhibiting fibers were prepared by covering polyester (95 wt%) as a sheath component on a core component made of 65 wt% nylon 6 blended with 5 wt% of a static inhibiting component containing 35 wt% carbon powder, forming 20-denier monofilaments.

[0028]

Although the obtained wiping cloth had an improved static inhibiting property, when the cloth was used in the wiping processing of semiconductor devices, it was found that traces of carbon powder were attached on the surface of the semiconductor substrate, and dielectric breakdown took place. This is inappropriate for practical application.

[0029]

Effects of the invention

This invention provides a type of wiping cloth without fluffing in cutting and with little dust generation. The wiping cloth of this invention has an excellent wiping property and wiping ability, and is free of hydrophilic and electroconductive substances. Consequently, it has an extraordinary reliability. As a result, it can be used as a wiping cloth for precision machines and products as well as equipment for manufacturing liquid crystal materials, semiconductor devices, etc.